UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/521,849	01/21/2005	Tobias Georg Tolle	DE 020184	6182

24737 7590 03/05/2008
PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
BAISA, JOSELITO SASIS	

ART UNIT	PAPER NUMBER
2832	

MAIL DATE	DELIVERY MODE
03/05/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

UNITED STATES DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
10521849	1/21/2005	TOLLE ET AL.	DE 020184

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
JOSELITO BAISA	
ART UNIT	PAPER
2832	20080303

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

An English translation of the reference EP 0522475 is included. This is a supporting document of the Examiner's Answer.

ELVIN ENAD
SUPERVISORY PATENT EXAMINER

/J. B./
Examiner, Art Unit 2832

PTO-90C (Rev.04-03)

PTO 06-2909

CY=EP DATE=19960522 KIND=B1
Error! Bookmark not defined.PN=522 475

INDUCTIVE COMPONENT AND PROCESS FOR ITS MANUFACTURE
[Induktives Bauelement und Verfahren zu seiner Herstellung]

Juergen Pilniak, et al.

UNITED STATE PATENT AND TRADEMARK OFFICE
Washington, D.C March 2006

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	EP
DOCUMENT NUMBER	(11):	EP 0 522 475 B1
DOCUMENT KIND	(12):	WO
PUBLICATION DATE	(43):	19930113
APPLICATION NUMBER	(21):	92111382.5
DATE OF FILING	(22):	19920704
ADDITION TO	(61)	
INTERNATIONAL CLASSIFICATION	(51):	H01F 27/32; H01F 27/28; H01F 41/12
PRIORITY	(30):	July 10, 1997 [DE] 4122796
INVENTORS	(72):	PILNIAK, JUERGEN; STRUCK, HERMANN
APPLICANT	(71):	ABB PATENT GMBH
DESIGNATED CONTRACTING STATES	(81):	AT DE FR GB IT
TITLE	(54):	INDUCTIVE COMPONENT AND PROCESS FOR ITS MANUFACTURE
FOREIGN TITLE	[54A]:	INDUKTIVES BAUELEMENT UND VERFAHREN ZU SEINER HERSTELLUNG

Specification. /2*

The invention relates to an inductive component having at least two windings, and a process for manufacturing such a component.

Inductive components are for example transformers, repeating coils, converters or reactance coils.

It is generally known that such inductive components according to the prior art can be produced by winding enamel-insulated round copper wires or insulated flat copper ribbons onto coil forms as the winding support. To insulate the windings against one another, insulating films are wound at the same time or multichamber coil forms are used. In many cases, additional resin encapsulation or impregnation is necessary.

The known inductive components have a relatively large unit volume and require high material inputs. Production requires complex winding machines or wage-intensive production processes.

EP-A2-0 435 461 discloses an inductive component and a process for its production, instead of conventional wire windings multilayer stacks of insulating material layers and structured metal layers being used. Thus the overall height of the inductive component can be better matched to that of other circuit components. A structured metal layer here forms one turn of a coil. Several turns can be produced using metal pins by series connection of individual turns.

On this basis, the object of the invention is to devise such an inductive component executed in a stack construction and a process for its manufacture which can meet increased demands with respect to electrical insulation, compact and economically producible windings, and low power loss.

---

* Number in the margin indicates pagination in the foreign text.

This object is achieved by an inductive component, especially a transformer, with at least two windings, of which each can have one or more turns, the insulating material layers and the structured metal layers being stacked on top of one another, and electrical connections between the structured metal layers with which contact is to be made being produced by means of metallic connecting pins. The insulating material layers are made from a material which can deform under the action of pressure and temperature. To form windings with several turns, helically structured metal layers are used. The laminated stack is baked during the production process into a common winding stack electrically insulated on all sides by the action of pressure and temperature, the insulating material layers being made with a somewhat larger area than the metal layers. The connecting pins for producing electrical connections in the winding stack are square or hexagonal pins which are pressed into the winding stack at selected points in holes perpendicular to the plane of the layers and are cold welded.

Moreover, as claimed in the invention a process for manufacturing an inductive component as claimed in claim 4 is suggested.

Advantageous embodiments and one preferred process for manufacturing the inductive component as claimed in the invention will become apparent from the following description of one exemplary embodiment and the claims.

The components as claimed in the invention are characterized by an especially small unit size and by specific material savings, since for example a separate coil form is not required. Electrical insulation requirements can be met with a smaller space requirement. The inductive components can be economically produced and have advantageous technical

data, especially high useful inductance, low power loss, and thus good efficiency.

A detailed description of the invention is given below using one exemplary embodiment shown in the drawings.

Figures 1a and b show the transformer arrangement,

Figure 2 shows a diagram of the transformer,

Figure 3 shows the schematic structure of the winding stack of the transformer,

Figure 4 shows a winding stack,

Figures 5a to f show metal parts of the winding stack,

Figure 6 shows the metal parts which are shown in Figs. 5a and 5b placed on top of one another,

Figure 7 shows an insulating material layer.

Figure 1a shows a front view and Fig. 1b shows a side view of a transformer **1** as claimed in the invention. The transformer **1** contains a core **2** and a winding stack **3** with terminals **4** which are labelled individually 4.11, 4.13, 4.21, 4.22 and 4.23 according to the terminals shown in Fig. 2. Moreover Fig. 1a shows holes **5** into which the connecting pins **6** (Fig. 5) are inserted.

Figure 2 shows the electrical diagram of the transformer **1** shown in Figs. 1a and 1b. The transformer **1** has two primary windings **7a** and **7b**, and two secondary windings **8a** and **8b**. The transformer **1** can contain other windings, for example for auxiliary voltages. In the exemplary embodiments shown in Figs. 1a, 1b and 2, the primary windings **7a** and **7b** are series connected, using a bridge **13** which is implemented by means of connecting pins **6** in the row of holes **5** which is the upper one in Fig. 1, as becomes understandable by comparison with Figs. 5a and 5b.

Likewise the secondary windings **8a** and **8b** are electrically series /3 connected, but the metal part **11** shown in Fig. 5e and connecting pins **6** being used to implement a secondary-side connecting point **14** which is brought out as a terminal **4.22**.

Figure 3 schematically shows the laminated structure of the winding stack **3** for the exemplary embodiment shown in the other figures. Here the following are stacked on top of one another: a first insulating material layer **9**, the second primary winding **7b**, another insulating layer **9**, the second secondary winding **8b**, an insulating layer **9**, the first secondary winding **8a**, an insulating layer **9**, the first primary winding **7a**, an insulating layer **9**, a metal part (see Fig. 5e) for producing the secondary-side connection to the winding ends **14.1** and **14.2** via (not shown in Fig. 3) connecting pins **6** and an upper insulating layer **9**. The insulating material layers **9** of the individual planes are dimensioned with respect to their thickness according to the respective insulation requirements. The insulating material layers are made with a somewhat larger area than the metal layers **11**, so that by baking the insulating layers **9** in one production step in which the action of temperature and pressure causes deformation of the insulating material layers and melting of the resin contained therein, in the edge area **10** and in the intermediate spaces of the structured metal layers **11** a closed, electrically insulating layer is achieved. The meltable resin sets as it cools and creates a connection of the layers of the winding stack which can no longer be broken. The insulating material layers **9** can be made as multilayer glass fiber mats or plates, and by choosing a corresponding number of layers the respective insulation requirements can be met. For example, to insulate several secondary

windings among one another, a smaller number of layers than for insulating between the primary and secondary windings can be sufficient.

However, the insulating material layers **9** can also be other insulating materials, such as for example ceramic plates, which can be connected to structured copper foils, for example, in a direct connection process.

Figure 4 shows the winding stack **3** of the transformer shown in Fig. 1.

Figures 5a to 5f show the metal parts of the winding stack **3**. Figures 5a to 5d show structured metal layers **11** which are made as copper sheets, for example 0.5 mm thick. The structuring for flat, for example 5 or 8 mm wide, helical turns of a coil can be achieved by punching, etching or other processes. In doing so moreover molded-on external terminals **4.11**, **4.13**, **4.21** and **4.23** are produced. To produce the primary winding with terminals **4.11** and **4.13**, two partial windings **7a** and **7b** with three turns each are used. The winding ends **13.1** and **13.2** enclosed in the helices are connected to one another to produce the bridge **13** shown in Fig. 2. To do this, the two partial windings **7a** and **7b** are placed on top of one another with the insertion of an insulating material layer **9** in between, as is shown in Fig. 6. The partial windings **7a** and **7b** are made identically, but are placed on top of one another mirror-imaged to one another, so that the winding ends **13.1** and **13.2** lie on top of one another and can be connected to one another by means of connecting pins 6 for implementing the bridge **13**.

The secondary windings **8a** and **8b** are made similarly and placed on top of one another, however the bridge **14** being implemented by

connecting the winding ends **14.1** and **14.2** to the metal piece shown in Fig. 5e, in turn by means of connecting pins **6**, of which one is shown in Fig. 5f. The arrangement of the metal piece which is shown in Fig. 5e and which is moreover the terminal **4.22** is indicated in Fig. 1 with broken lines.

Square pins of copper alloy are used as the connecting pins **6**; they are dimensioned with respect to the holes **5** such that when the pins are pressed into the holes **5**, cold welding occurs. It goes without saying that the pins can also have a different shape and that the electrical and mechanical connection can also be produced in some other way.

Figure 7 shows one preferred embodiment of the insulating material layer **9**, specifically a woven glass fiber fabric mat or plate which contains a meltable resin. As in the structured metal layers **11**, in the insulating material layer **9** a cutout **15** for the core **2** is kept open.

Finally, one preferred process for producing the winding stack of the inductive component as claimed in the invention is described in summary using the exemplary embodiment shown in the drawings. The process can be regarded as a combination of baking technology, encapsulation technology, plastic housing technology and plastic film technology.

The winding stack is produced proceeding from prefabricated punched copper sheets and insulating material boards in the following steps:

a) Several layers of insulating material or of metal sheets structured into helical turns and terminals are stacked on top of one another in alternation,

- the stack being started and ended with one insulating material layer each,
- the insulating material layers being adapted to the respective insulation requirements, for example by the corresponding layer thickness,
- the insulating material layers consisting of a material which melts only at a very high temperature, /4 for example a glass fabric or a ceramic plate and being combined with a conversely low-melting cement, for example a resin, for example by intercalation or coating, and
- winding ends and terminal sheets to be electrically connected lying on top of one another in an overlapping manner, but being separated by insulating material layers;

b) The laminated stack is baked under the action of pressure and temperature, the insulating material layers and especially the cement which melts during this process tightly surrounding the structured metal sheets and filling the intermediate spaces in the stack;

c) To produce electrical connections between individual windings or winding parts, and between the winding ends and winding terminals, holes are made perpendicularly to the plane of the layers at the points at which the metal layers to be connected overlap, and connecting pins, preferably square pins, are pressed in and in doing so cold welded to the sheets, a strong and gastight connection being formed.

Claims

1. Inductive component, especially a transformer (1), having at least two windings (7a, 7b, 8a, 8b), of which each can have one or more turns,

- the insulating material layers (9) and the structured metal layers (11) being stacked on top of one another, and
- electrical connections between the structured metal layers (11) with which contact is to be made being produced by means of metallic connecting pins (6),

characterized in that

a) the insulating material layers (9) are made from a material which can deform under the action of pressure and temperature,

b) to form windings (7a, 7b, 8a, 8b) with several turns, helically structured metal layers (11) are used,

c) the laminated stack (9, 11) is baked during the production process into a common winding stack (3) electrically insulated on all sides by the action of pressure and temperature, the insulating material layers (9) being made with a somewhat larger area than the metal layers (11),

d) the connecting pins (6) for producing electrical connections in the winding stack (3) are square or hexagonal pins which are pressed into the winding stack (3) at selected points in holes (5) perpendicular to the plane of the layers and are cold welded.

2. Inductive component as claimed in Claim 1, wherein the structured metal layers (11) for forming the windings (7a, 7b, 8a, 8b) consist of copper or aluminum sheet and are made for example by punching as helical sheet ribbon which lies flat in one plane.

3. Inductive component as claimed in Claim 1 or 2, wherein the insulating material layers (9) consist of single-layer or multilayer glass fiber fabric plates, the intermediate spaces in the fabric being filled with a meltable resin.

4. Process for manufacturing an inductive component, for example a transformer, several windings of the component being located within a winding stack, characterized in that the winding stack is produced in the following steps:

a) Several layers of insulating material or of metal sheets structured into helical turns and terminals are stacked on top of one another in alternation,

- the stack being started and ended with one insulating material layer each,
- the insulating material layers being adapted to the respective insulation requirements, for example by the corresponding layer thickness,
- the insulating material layers consisting of a material which melts only at a very high temperature, for example a glass fabric or a ceramic plate, and being combined with a conversely low-melting cement, for example a resin, for example by intercalation or coating, and
- winding ends and terminal sheets to be electrically connected lying on top of one another in an overlapping manner, but being separated by insulating material layers;

b) The laminated stack is baked under the action of pressure and temperature, the insulating material layers and especially the cement which melts during this process tightly surrounding the

structured metal sheets and filling the intermediate spaces in the stack;

c) To produce electrical connections between individual windings or winding parts, and between the winding ends and winding terminals, holes are made perpendicularly to the plane of the layers at the points at which the metal layers to be connected overlap, and connecting pins, preferably square pins, are pressed in and in doing so cold welded to the sheets, a strong and gastight connection being formed.

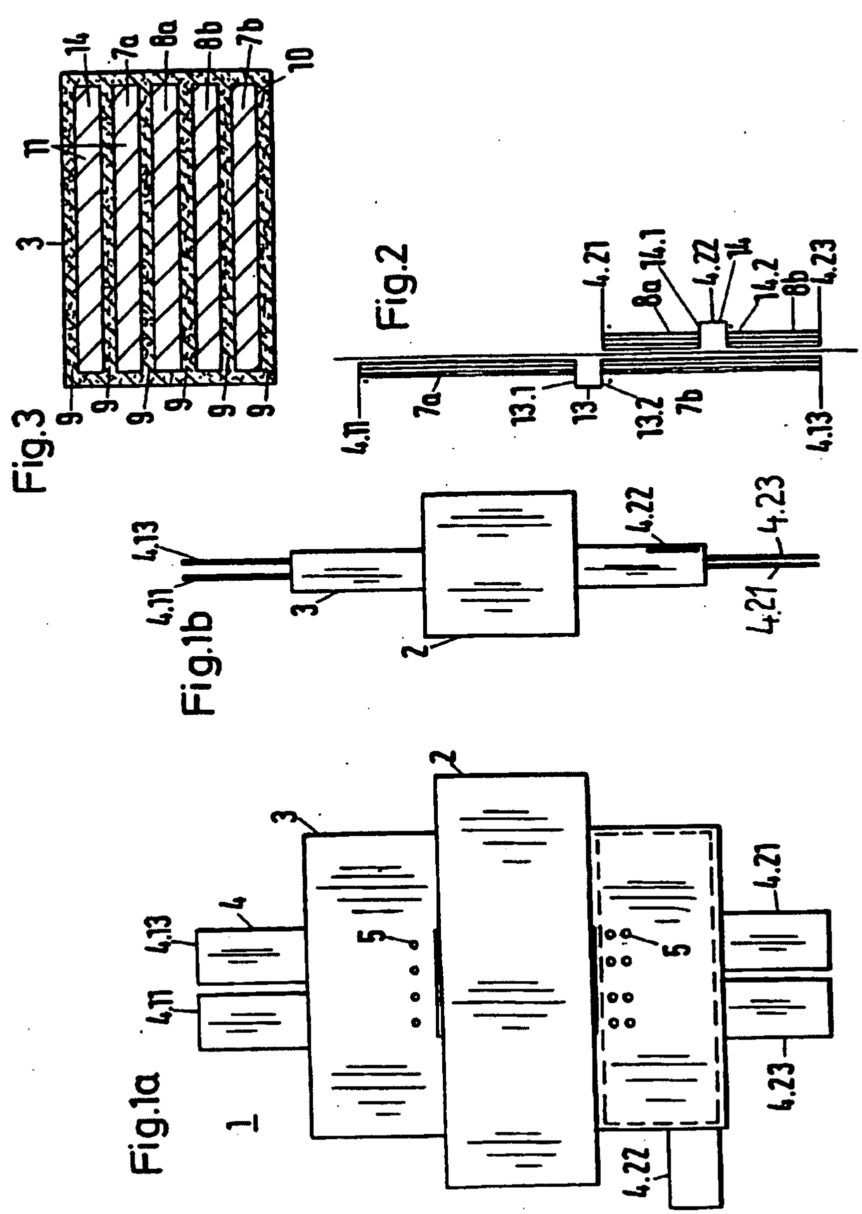


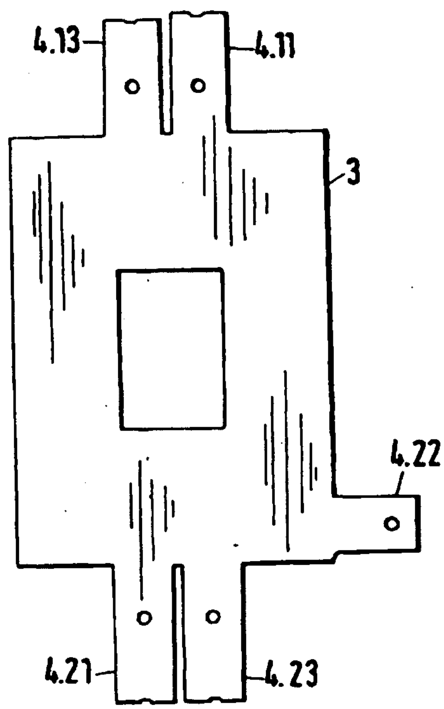
Fig.3

Fig.2

Fig.1b

Fig.1a

Fig.4



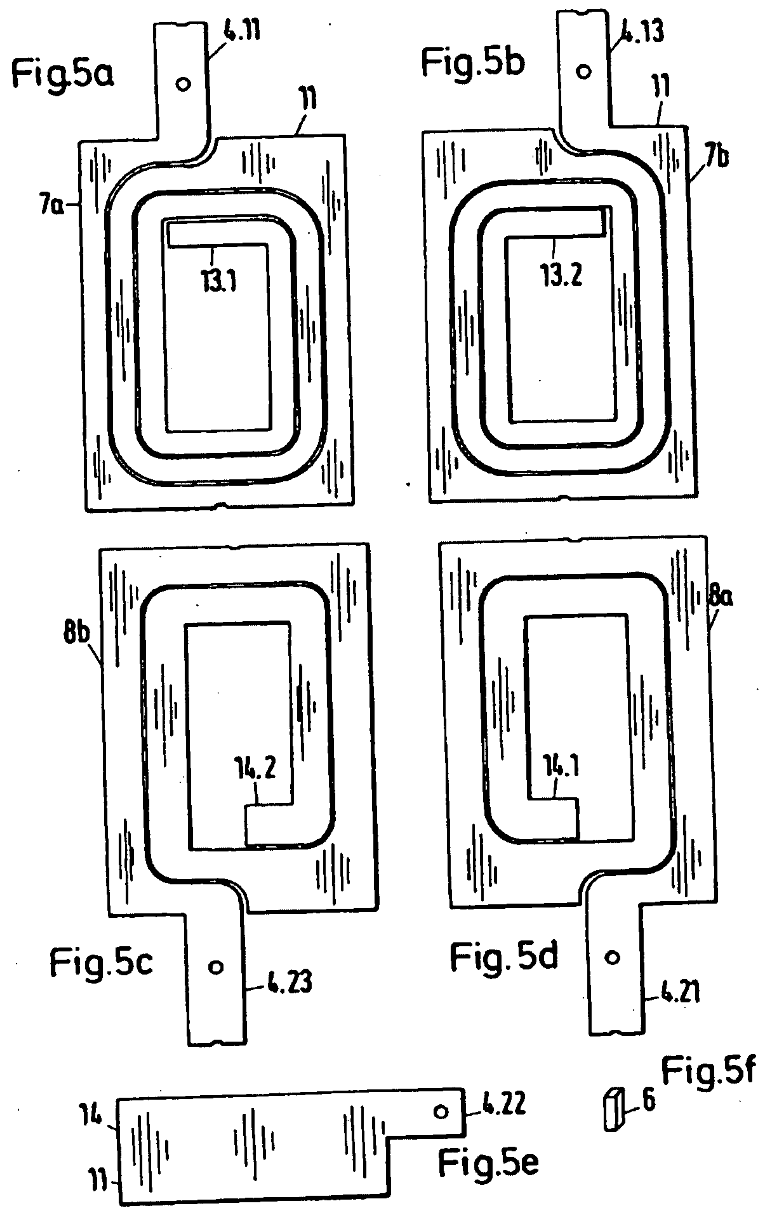


Fig.5a
4.11
11
7a
13.1
Fig.5b
4.13
11
7b
13.2
8b
14.2
8a
14.1
Fig.5c
4.23
Fig. 5d
4.21
14
11
4.22
Fig.5e
6
Fig.5f

Fig.6

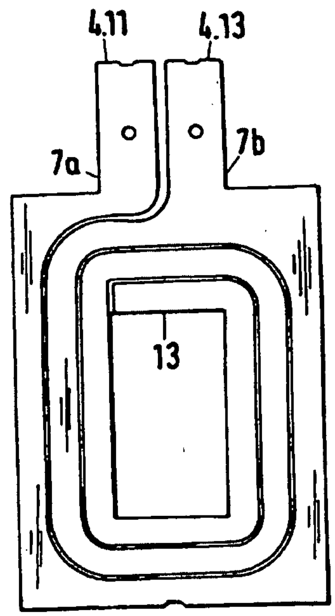


Fig.7